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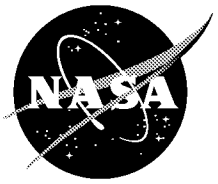

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara Conrad, Editors

Volume 210

BOREAS TF-11 Biomass Data over the SSA-Fen

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Available from:

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BOREAS TF-11 Biomass Data over the SSA-Fen

David Valentine

Summary

The BOREAS TF-11 team collected several data sets in its efforts to fully describe the flux and site characteristics at the SSA-Fen site. This data set contains plant cover, standing crop of plant biomass, and estimated net primary productivity at each chamber site at the end of the 1994 field season. The measurements were conducted as part of a 2 x 2 factorial experiment in which we added carbon (300 g/m^2 as wheat straw) and nitrogen (6 g/m^2 as urea) to four replicate locations in the vicinity of the TF-11 tower. The data are stored in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TF-11 Biomass Data over the SSA-Fen

1.2 Data Set Introduction

This data set contains standing crop of plant biomass and estimated net primary productivity (NPP) at each chamber site at the end of the 1994 field season. The measurements were conducted as part of a 2 x 2 factorial experiment in which we added carbon (300 g/m^2 as wheat straw) and nitrogen (6 g/m^2 as urea) to four replicate locations in the vicinity of the Tower Flux (TF)-11 tower.

1.3 Objective/Purpose

Much of the area within the boreal forest biome consists of wetlands, in which large carbon stores and high water tables drive fundamentally different atmospheric interactions than occur under the other forest types studied by the BOReal Ecosystem-Atmosphere Study (BOREAS). One key difference is in the form carbon is emitted following soil microbial respiration; in wetlands, much of it is emitted as methane. Wetlands are the dominant influence of boreal forests on atmospheric methane.

This study was undertaken in order to assess responses of methane emissions in northern wetlands to potential changes in plant productivity, nitrogen availability, or both. Whiting and Chanton (1993) recently observed that methane emissions from wetlands across the globe are well related to NPP. This may be for a variety of reasons, including enhanced plant transport, increased methanogenic substrates from root exudates, increased litter input cascading to enhanced substrate availability for methanogenesis, or enhanced C and N mineralization of decomposing residues. Previous work by others and us (Valentine et al., 1994) has shown that substrate availability is a key constraint on methane production in wetlands. The present study was an effort to test whether substrate manipulation results from laboratory studies could be mirrored under field conditions.

1.4 Summary of Parameters

We report the standing crop of live plant biomass, by growth form, clip-harvested from our flux chambers in mid-September 1994. Based on these and the procedure outlined by Klinger et al. (1994), we also estimated NPP by growth form.

1.5 Discussion

These data were collected from a set of small locations within the fen, and therefore no one location represented the entire study site. In fact, the fen in which this work was conducted was characterized by a large-scale gradient of vegetation, microtopography, and hydrology such that the study site itself is representative only of the portion of the fen in which it was located (i.e., the lower 1/3).

These data were collected at the same site and over the same time period as Shashi Verma and his team measured methane and carbon dioxide fluxes using eddy correlation. Tim Arkebauer collected more detailed data on plant species composition and dominance at this site.

1.6 Related Data Sets

BOREAS TE-06 Biomass Estimate Data
BOREAS TE-18 Biomass Density Image of the SSA
BOREAS TF-11 CO2 and CH4 Concentration data from the SSA-Fen
BOREAS TF-11 CO2 and CH4 Flux data from the SSA-Fen
BOREAS TGB-03 Plant Species Composition Data over the NSA-Fen

2. Investigator(s)

2.1 Investigator(s)

David Valentine
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2.2 Title of Investigation

Influence of Substrate Characteristics and Other Environmental Factors on Methane Emissions from the BOREAS Southern Study Area Fen Site: IV. Standing Crop

2.3 Contact Information

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3. Theory of Measurements

Above-ground biomass was assessed by clip-harvesting at the end of the growing season, separating by taxonomic unit (species where possible), and weighing oven dry corrected samples. Data were aggregated and reported by growth form.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

The clip harvest occurred from 13-Sep through 16-Sep-1994, as many of the plants had begun to senesce.

4.1.2 Source/Platform

All chamber sites were fitted with stainless steel bases cut into the surface 10 cm of peat at the beginning of the season. All bases remained in place during the entire summer. We clipped the vegetation contained in each base to obtain end-of-season above-ground plant biomass.

4.1.3 Source/Platform Mission Objectives

Recent papers (e.g., Whiting and Chanton, 1993) have suggested that CH_4 emissions are positively related to plant productivity. As we observed substantial variability among the chamber bases with respect to above-ground plant biomass, we decided to harvest them to examine possible relationships between above-ground biomass and CH_4 emissions.

4.1.4 Key Variables

COVER - Fraction of area covered by taxon BIOMASS - g/m^2 -Oven dry weight of growth form's above-ground parts NPP - $g/m^2/y$ - Estimated above-ground net primary productivity

4.1.5 Principles of Operation
None given.

4.1.6 Sensor/Instrument Measurement Geometry
None given.

4.1.7 Manufacturer of Sensor/Instrument
None given.

4.2 Calibration

4.2.1 Specifications

4.2.1.1 Tolerance
None given.

4.2.2 Frequency of Calibration
None given.

4.2.3 Other Calibration Information
None given.

5. Data Acquisition Methods

After monitoring CH_4 and CO_2 fluxes at a number of chamber collars through the growing season, we estimated plant cover by eye, harvested all above-ground plant biomass at each collar, and classified it according to growth form: moss, shrub, graminoid, and herbaceous. All samples were oven dried at 30 °C for 48 hours before weighing.

6. Observations

6.1 Data Notes
Plant identification to genus and species was not attempted because at the time of clipping, senescence had obscured many foliar details and flowering had long past for most species.

6.2 Field Notes
None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage
All measurements were made along two transects identified by their location relative to the TF-11 micrometeorology tower: a north transect (NA and NB platforms) and a south transect (SA and SB platforms). All measurements were made within 70 m of the TF-ll tower, whose North American Datum of 1983 (NAD83) coordinates are 53.80206°N, 104.61798°W.

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution

These data are point measurements at the given locations.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Plant cover, biomass, and NPP data are from clip-harvests performed 13-Sep through 16-Sep-1994, covering accumulated plant biomass for the 1994 growing season (for herbaceous and graminoid species) and previous growing seasons (for shrubs and bryophytes).

7.2.2 Temporal Coverage Map

None.

7.2.3 Temporal Resolution

One's objective determines when above-ground biomass should be collected. Peak biomass is collected when biomass is largest, and is useful in relating to peak CH_4 or CO_2 flux rates. End-of-season biomass is collected at senescence, and is useful for estimating likely litter inputs to the ecosystem. We were constrained by our need to monitor CH_4 fluxes at the sites where ultimately above-ground biomass would also be determined.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

```
         Column Name
-----------------------------
SITE_NAME
SUB_SITE
START_OBS_DATE
END_OBS_DATE
C_ADDED
N_ADDED
COVER_TYPE
AREA_FRACTION
DRY_WEIGHT_BIOMASS_DENSITY
NPP
SITE_COMMENTS
CRTFCN_CODE
REVISION_DATE
```

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
START_OBS_DATE	The date and time at which collection of the referenced data commenced.
END_OBS_DATE	The date and time at which collection of the referenced data was terminated.
C_ADDED	Estimated amount of carbon contained in the wheat straw that was added to the plot.
N_ADDED	Estimated amount of nitrogen contained in the urea that was added to the plot.
COVER_TYPE	The dominant species, vegetation or type of land cover that exists at the location.
AREA_FRACTION	Fraction of the area covered by the given cover type.
DRY_WEIGHT_BIOMASS_DENSITY	Oven-dried weight of the above-ground vegetation.
NPP	Estimated above-ground net primary productivity.
SITE_COMMENTS	Descriptive information to clarify or enhance the site information.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
START_OBS_DATE	[none]
END_OBS_DATE	[none]
C_ADDED	[grams C][meter^-2]
N_ADDED	[grams C][meter^-2]
COVER_TYPE	[none]
AREA_FRACTION	[unitless]

DRY_WEIGHT_BIOMASS_DENSITY	[grams][meters^-2]
NPP	[grams][meters^-2][year^-1]
SITE_COMMENTS	[none]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
START_OBS_DATE	[Investigator]
END_OBS_DATE	[Investigator]
C_ADDED	[Investigator]
N_ADDED	[Investigator]
COVER_TYPE	[Investigator]
AREA_FRACTION	[Investigator]
DRY_WEIGHT_BIOMASS_DENSITY	[Balance]
NPP	[Calculated by Investigator]
SITE_COMMENTS	[Investigator]
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-FEN-FLXTR	SSA-FEN-FLXTR	None	None	None	None
SUB_SITE	9TF11-BIO01	9TF11-BIO08	None	None	None	None
START_OBS_DATE	21-JUL-94	02-AUG-94	None	None	None	None
END_OBS_DATE	17-SEP-94	17-SEP-94	None	None	None	None
C_ADDED	0	300	None	None	None	None
N_ADDED	0	6	None	None	None	None
COVER_TYPE	N/A	N/A	None	None	None	None
AREA_FRACTION	0	.55	None	None	None	None
DRY_WEIGHT_BIOMASS_DENSITY	.3	694.2	None	None	None	None
NPP	.1	312.8	None	None	None	None
SITE_COMMENTS	N/A	N/A	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	09-SEP-98	09-SEP-98	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the

```
                      parameter value, but the value was deemed to be
                      unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the
                      instruments detection limits.  This is used to
                      indicate that an attempt was made to determine the
                      parameter value, but the analysis personnel determined
                      that the parameter value was below the detection
                      limit of the instrumentation.
Data Not Cllctd    -- This value indicates that no attempt was made to
                      determine the parameter value.  This usually
                      indicates that BORIS combined several similar but
                      not identical data sets into the same data base table
                      but this particular science team did not
                      measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A   -- Indicates that the value is not applicable to the respective column.
None  -- Indicates that no values of that sort were found in the column.
--------------------------------------------------------------------------------
```

7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

```
SITE_NAME,SUB_SITE,START_OBS_DATE,END_OBS_DATE,C_ADDED,N_ADDED,COVER_TYPE,
AREA_FRACTION,DRY_WEIGHT_BIOMASS_DENSITY,NPP,SITE_COMMENTS,CRTFCN_CODE,
REVISION_DATE
'SSA-FEN-FLXTR','9TF11-BIO01',21-JUL-94,17-SEP-94,0,0,'bryophyte',.1,3.3,2.3,
'Hummock: North of Tower, along transect A','CPI',09-SEP-98
'SSA-FEN-FLXTR','9TF11-BIO01',21-JUL-94,17-SEP-94,0,0,'graminoid',.4,99.6,
99.6,'Hummock: North of Tower, along transect A','CPI',09-SEP-98
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) is the measurement(s) made for a given site on a given day.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

NPP was estimated as BIOMASS * PBR, where PBR (the productivity/biomass ratio) was taken from Klinger et al. (1994) Table 1. All graminoid and herbaceous plants and shrub leaves had a PBR of 1.0 (i.e. all biomass was produced during the current growing season). Shrub stems were given a PBR of 0.21 and bryophytes were given a PBR of 0.68.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables

See Section 9.1.1.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

The largest source of error for both biomass measurements and NPP calculations is the below-ground component. All values reported here are for above-ground parts only; the reader should exercise care in extrapolating from these to ecosystem biomass and NPP values. The NPP estimates are calculated based on assumed ratios of current production to biomass; although derived for boreal ecosystems, their applicability to this site and species composition is untested. Finally, the influence of the permanently installed chamber collars and periodically placed chambers is unknown but perhaps important. Possible mechanisms include severance of plant roots and rhizomes by the collar placement, greater thermal conductivity of steel into the rooting zone, and potential lensing by the chamber film causing damage to foliage during flux measurement prior to the clip harvest.

10.2 Quality Assessment

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

The above-ground plant biomass data are fairly solid as sufficient care was exercised during the growing season to cause minimal disturbance and during the clip harvest to sample quantitatively. For the reasons noted in Sections 9.1 and 10.1, care should be taken in interpreting estimated NPP as it was calculated rather than measured through sequential harvests.

10.2.3 Measurement Error for Parameters
None given.

10.2.4 Additional Quality Assessments
None given.

10.2.5 Data Verification by Data Center
Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
See Sections 9.1 and 10.1.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
See Sections 9.1 and 10.1.

11.4 Other Relevant Information
None given.

12. Application of the Data Set

Several avenues are being pursued in publications now being produced to answer the following questions:

- How do CH_4 flux measurements compare by technique used in measurement?
- How and why do CH_4 flux measurements vary through time and across the landscape?
- Does plant productivity limit CH_4 emissions?

13. Future Modifications and Plans

None given.

14. Software

14.1 Software Description
We used only commercially available software, mostly the Quattro Pro spreadsheet.

14.2 Software Access
None given.

15. Data Access

The biomass data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None.

17.2 Journal Articles and Study Reports

Klinger, L.F., P.R. Zimmerman, J.P. Greenberg, L.E. Heidt, and A.B. Guenther. 1994. Carbon trace gas fluxes along a successional gradient in the Hudson Bay lowland. Journal of Geophysical Research 99:1469-1494.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

Valentine, D.W., E.A. Holland, and D.S. Schimel. 1994. Ecosystem and physiological controls over methane production in northern wetlands. Journal of Geophysical Research 99(D1):1563-71.

Whiting, G.J. and J.P. Chanton. 1993. Primary production control of methane emission from wetlands. Nature 364:794-5.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

ASCII - American Standard Code for Information Interchange
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
CD-ROM - Compact Disk-Read-Only Memory
DAAC - Distributed Active Archive Center
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
GIS - Geographic Information System
GSFC - Goddard Space Flight Center
HTML - HyperText Markup Language
NAD83 - North American Datum of 1983
NASA - National Aeronautics and Space Administration
NPP - Net Primary Productivity
NSA - Northern Study Area
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
PBR - Productivity/Biomass Ratio
SSA - Southern Study Area
TE - Terrestrial Ecology
TF - Tower Flux
TGB - Trace Gas Biogeochemistry
URL - Uniform Resource Locator

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When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

Valentine, D.W. 1996. Influence of substrate characteristics and other environmental factors on methane emissions from the BOREAS Southern Study Area fen site. IV. Above-ground plant cover, biomass, and estimated productivity.

If using data from the BOREAS CD-ROM series, also reference the data as:

Valentine, D., "Influence of Substrate Characteristics and Other Environmental Factors on Methane Emissions from the BOREAS Southern Study Area Fen Site: IV. Standing Crop." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

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The BOREAS TF-11 team collected several data sets in its efforts to fully describe the flux and site characteristics at the SSA-Fen site. This data set contains plant cover, standing crop of plant biomass, and estimated net primary productivity at each chamber site at the end of the 1994 field season. The measurements were conducted as part of a 2 x 2 factorial experiment in which we added carbon (300 g/m^2 as wheat straw) and nitrogen (6 g/m^2 as urea) to four replicate locations in the vicinity of the TF-11 tower. The data are stored in tabular ASCII files.

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